Remarks

I. Status of claims

Claims 1-30 were pending.

Claims 10, 20, and 30 have been canceled without prejudice.

II. Objection to the specification

The abstract has been amended in a way that addresses the Examiner's concerns. The objection to the abstract now should be withdrawn.

III. Objections to the claims

The claims have been amended in ways that address the Examiner's concerns. The objections to the claims now should be withdrawn.

IV. Claim rejections under 35 U.S.C. § 102

The Examiner has rejected claims 1, 10, 11, 20, 21, and 30 under 35 U.S.C. § 102(b) over Wang (U.S. 5,557,684). Claims 10, 20, and 30 have been canceled without prejudice

A. Claim 1

Independent claim 1 has been amended and now recites:

> 1. A machine-implemented method of processing a sequence of image frames, comprising:
>
> computing respective sets of motion vectors for pairs of the image frames;
>
> classifying the computed motion vectors into motion classes;
>
> identifying motion clusters in the image frames based at least in part on the motion classes;
>
> determining for each of the identified motion clusters a respective spatiotemporal consistency value indicating persistence of the motion cluster in a respective spatial region across neighboring ones of the image frames;

selecting one of the identified motion clusters as a motion stabilization reference based on the spatiotemporal consistency values;

determining a motion model describing motion of the motion stabilization reference in the image frame sequence; and

producing a motion-stabilized version of the sequence of image frames based on the motion model.

Wang discloses a system for encoding an image sequence into multiple layers each of which represents a respective region of coherent motion and associated motion parameters. The layers are ordered by depth in the image, and each layer includes information describing how the layer should be manipulated or transformed over time (see, e.g., col. 1, lines 19-25). The image sequence is recreated (or decoded) by combining the layers in order and warping them over time (see, e.g., col. 1, lines 40-43).

The system 12 includes a local motion estimator 22, a coherent motion region estimator 24a, and a motion estimator 24b (see FIG. 3). The local motion estimator 22 estimates movements of local pixel areas between consecutive frames (see col. 5, lines 16-31). The coherent motion region estimator 24a identifies regions of coherent motion from an analysis of the motions associated with neighboring frames with arbitrary non-overlapping regions used for analysis of the first pair of frames in the sequence (see col. 5, lines 37-38, and col. 10, lines 4-7). The motion estimator 24b produces a motion model for each of the identified regions of coherent motion, groups similar models, and produces a composite motion model for each group (see col. 5, lines 35-42). The coherent motion region estimator 24a associates individual pixels with the composite motion models (see col. 5, lines 43-50). The motion model parameters and information identifying the coherent motion regions are stored (see col. 5, lines 51-55). This process is repeated for each frame pair (see col. 5, line 61 - col. 6, line 7).

"A layer extraction processor 26 combines the coherent region information and the associated motion model information for all the frames and produces one layer for each region" (col. 6, lines 8-11). The system 12 then produces a layer intensity map from composite pixel intensity values for every pixel location within each region (see col. 6, lines 21-25). The processor 26 sends the layer information to a data storage and/or transmission device for storage and/or transmission. According to Wang, "A sequence of 30 image

frames, for example, can be represented by a few still images of the layers plus six parameters per frame per layer" (col. 6, lines 55-57).

Wang does not disclose "determining for each of the identified motion clusters a respective spatiotemporal consistency value indicating persistence of the motion cluster in a respective spatial region across neighboring ones of the image frames," as now recited in claim 1. As explained above, the coherent motion region estimator 24a determines the regions of coherent motion from an analysis of the motions associated with neighboring frames with arbitrary non-overlapping regions used for analysis of the first pair of frames in the sequence (see col. 10, lines 4-7). Wang does not even hint that this process involves "determining for each of the identified motion clusters a respective spatiotemporal consistency value indicating persistence of the motion cluster in a respective spatial region across neighboring ones of the image frames."

Wang also does not disclose "selecting one of the identified motion clusters as a motion stabilization reference based on the spatiotemporal consistency values; determining a motion model describing motion of the motion stabilization reference in the image frame sequence; and producing a motion-stabilized version of the sequence of image frames based on the motion model," as now recited in claim 1.

The Examiner has stated that in col. 3, lines 40-57, Wang discloses "stabilizing the sequence of image frames with respect to a motion model computed for the motion cluster selected as the motion stabilization reference" (Office action, page 5, lines 1-4). Contrary to the Examiner's statement, however, Wang does not teaching anything about producing a motion-stabilized version of a sequence of image frames. In col. 3, lines 40-57, Wang describes the process of decoding the encoded layers representing regions of coherent motion and associated motion parameters to recreate the original image sequence. This disclosure does not disclose anything about motion compensation.

The Examiner also has stated that Wang discloses "selecting an identified motion cluster as a motion stabilization reference" in FIGS. 3, 8A, and 8B and col. 5, line 15 - col. 6. Nowhere in this disclosure, however, does Wang teach that a motion cluster is selected as a motion stabilization reference. In pertinent part, this disclosure only teaches that motion and boundaries associated with regions of coherent motion are determined (see, e.g., col. 6, lines 45-47). None of the regions of coherent motion, however, is selected as a motion stabilization reference. Since Wang's system does not perform motion stabilization, selecting

a motion stabilization reference would not serve any useful purpose. Moreover, the selection of a region of coherent motion (i.e., a moving object) as a motion stabilization reference would lead to undesirable motion compensation results (see, e.g., page 2, lines 7-11, of the specification of the instant application).

For at least these reasons, the rejection of claim 1 under 35 U.S.C. § 102(b) over Wang now should be withdrawn.

B. Claims 11 and 21

Each of claims 11 and 21 recites features that essentially track the pertinent features of independent claim 1 discussed above. Therefore, claims 11 and 21 are patentable over Wang for at least the same reasons explained above.

V. Claim rejections under 35 U.S.C. § 103

A. Claims 8, 9, 18, 19, 28, 29

The Examiner has rejected claims 8, 9, 18, 19, 28, and 29 under 35 U.S.C. § 103(a) over Wang in view of Heisele ("Motion-based object detection and tracking in color image sequence").

Claims 8 and 9 incorporate the features of independent claim 1; claims 18 and 19 incorporate the features of independent claim 11; and claims 28 and 29 incorporate the features of independent claim 21. Heisele does not make-up for the failure of Wang to teach or suggest the features of independent claims 1, 11, and 21 discussed above. Therefore, claims 8, 9, 18, 19, 28, and 29 are patentable over Wang and Heisele for at least the same reasons explained above.

In support of the rejection of claims 8, 18, and 28, the Examiner has stated that:

> ...Heisele in the same field of endeavor disclose wherein selecting a motion cluster as a motion stabilization reference comprises projecting each motion cluster from image frames to respective neighboring image frames, and computing respective measures of spatiotemporal consistency for the projected motion clusters (page 2 left column lines 23. A consistent segmentation results over time is seen as the reference motion cluster over the image frames.).

Contrary to the Examiner's statement, however, the mere statement that "we obtain consistent segmentation results over time" does not constitute a teaching that Heisele selects a motion cluster as a motion stabilization reference. The fact is that Heisele's system does not perform motion stabilization and, therefore, selecting a motion stabilization reference would not serve any useful purpose.

In addition, the Examiner has not pointed to any disclosure in Heisele that supports the statement that Heisele discloses "computing respective measures of spatiotemporal consistency for the projected motion clusters." Applicant asks the Examiner to point to a specific location in Heisele that discloses "computing respective measures of spatiotemporal consistency for the projected motion clusters."

In support of the rejection of claims 9, 19, and 29, the Examiner has stated that:

> ...Heisele in the same field of endeavor disclose wherein the motion cluster selected as a motion stabilization reference for a given reference image frame has a greater spatiotemporal consistency measure than other motion clusters across multiple image frames neighboring the given reference image frame (page one, right column lines 14-25. Even with the reduction of data from this method it stills generate more motion data across the images.).

The cited section of Heisele teaches that "Despite the early reduction of data in the color segmentation, this approach nevertheless generates motion information across the whole image." Contrary to the Examiner's statement, however, this teaching does not constitute a teaching that the motion cluster selected as a motion stabilization reference for a given reference image frame has a greater spatiotemporal consistency measure than other motion clusters across multiple image frames neighboring the given reference image frame. The fact is that Heisele's system does not perform motion stabilization and, therefore, selecting a motion stabilization reference would not serve any useful purpose.

B. Claims 2-6, 12-16, and 22-26

The Examiner has rejected claims 2-6, 12-16, and 22-26 under 35 U.S.C. § 103(a) over Wang in view of Ohm ("Feature-based cluster segmentation of image sequences").

Claims 2-6 incorporate the features of independent claim 1; claims 12-16 incorporate the features of independent claim 11; and claims 22-26 incorporate the features of

independent claim 21. Ohm does not make-up for the failure of Wang to teach or suggest the features of independent claims 1, 11, and 21 discussed above. Therefore, claims 2-6, 12-16, and 22-26 are patentable over Wang and Ohm for at least the same reasons explained above.

In support of the rejection of claims 6, 16, and 26, the Examiner has stated that:

> ... Ohm in the same field of endeavor disclose wherein motion vectors are re-classified with a modified clustering parameter in response to a determination that a computed spatiotemporal consistency measure is below a consistency threshold (figure 2 of page 3, page 3 paragraph "4 Segment merging based on local feature analysis" and "5 Segment tracking").

Contrary to the Examiner's statement, however, Ohm does not disclose that "motion vectors are re-classified with a modified clustering parameter in response to a determination that a computed spatiotemporal consistency measure is below a consistency threshold."

In FIG. 2, Ohm discloses the

> ...use [of] the forward motion vectors (same as used for local feature classification) to project a segment belonging to the foreground object at time t to the next frame at time t+1. Find segment(s) with the same label in the next frame, which are at any position overlapping with the projected segment... (Page 3, col. 1, § 5, line 6 - page 3, col. 2, line 4)

This disclosure does not teach or suggest anything about computing spatiotemporal consistency measures, much less anything about reclassifying motion vectors with a modified clustering parameter in response to a determination that a computed spatiotemporal consistency measure is below a consistency threshold.

On page 3, § 4, Ohm discloses

> Though the application of variable weighting to the motion feature results in relatively large segments, if object motion is homogeneous, there remain patches of small segments that cannot uniquely be allocated to object or background. These can be handled by a segment merging procedure, which is based on local feature analysis. The local feature analysis calculates the centroid according to (3), but only inside one individual segment. This is performed separately for the motion and color features. Segments can be merged, if either the difference in the motion feature is small and the motion is reliable for this segment, or if the difference in the color feature is small.

This disclosure does not teach or suggest anything about computing spatiotemporal consistency measures, much less anything about reclassifying motion vectors with a modified clustering parameter in response to a determination that a computed spatiotemporal consistency measure is below a consistency threshold.

C. Claims 7, 17, and 27

The Examiner has rejected claims 7, 17, and 27 under 35 U.S.C. § 103(a) over Wang in view of Ohm and Heisele.

Claim 7 incorporates the features of independent claim 1; claim 17 incorporates the features of independent claim 11; and claim 27 incorporates the features of independent claim 21. Heisele does not make-up for the failure of Wang to teach or suggest the features of independent claims 1, 11, and 21 discussed above. Therefore, claims 7, 17, and 27 are patentable over Wang, Ohm, and Heisele for at least the same reasons explained above.

VI. Conclusion

For the reasons explained above, all of the pending claims are now in condition for allowance and should be allowed.

Charge any excess fees or apply any credits to Deposit Account No. 08-2025.

Respectfully submitted,

Date: June 1, 2007

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